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US 5366164 A US 4665607 A

(58) Field of Search
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(54) Laser nozzle mounting

(57) A laser materials working apparatus for drilling or cutting through materials using a laser includes a nozzle (1) through which the laser beam is focussed on a work piece. The nozzle (1) is secured to a mounting face on the apparatus by a locate and clamp coupling which holds a face of the nozzle firmly against the mounting face on the apparatus. Such mounting comprises a rotary cam plate which engages lugs on the nozzle to clamp it to the mounting face. The nozzle may be exchangeable by an automatic mechanism.

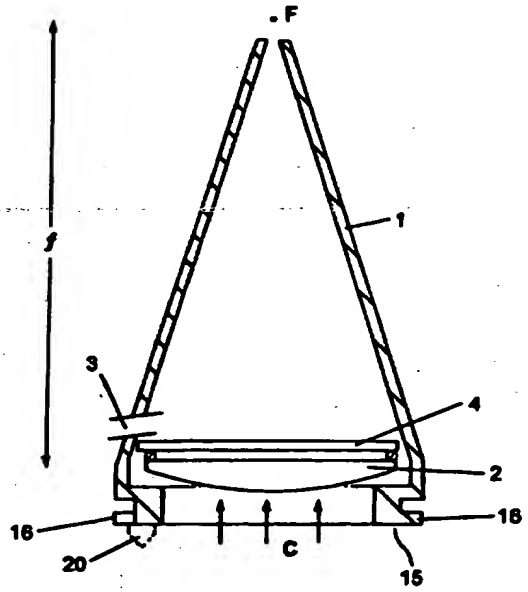

FIG.1

GB 2 299 777 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

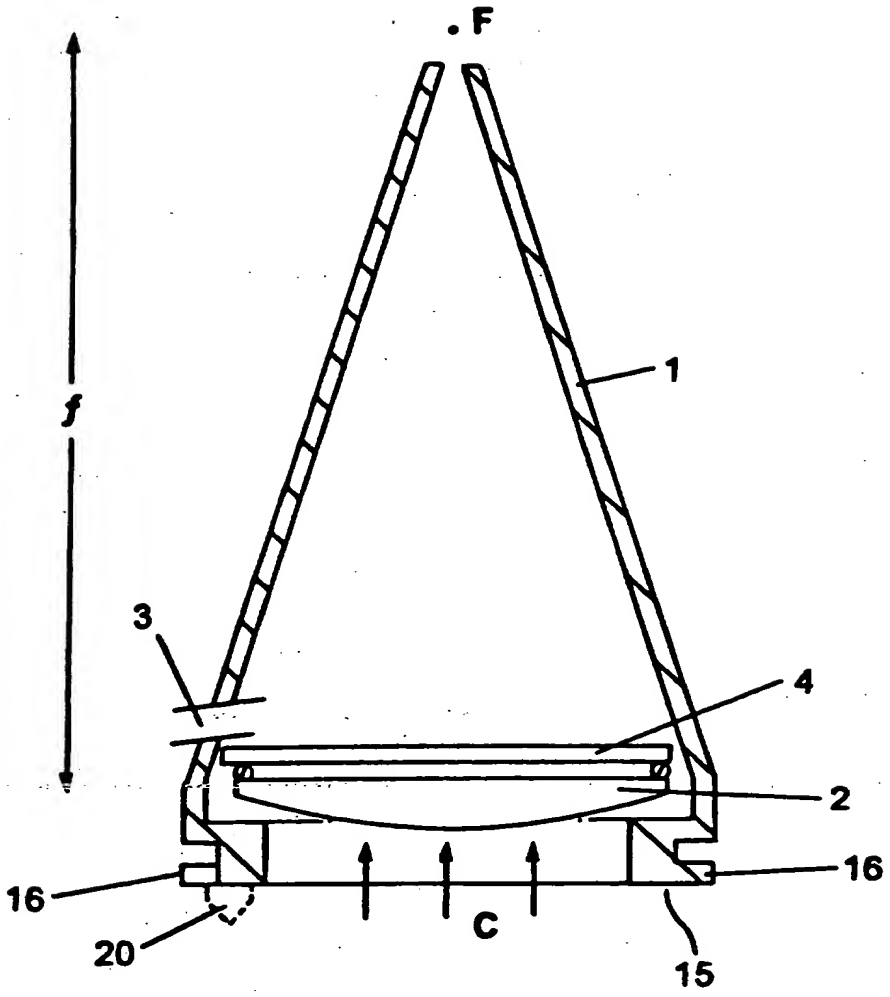

FIG.1

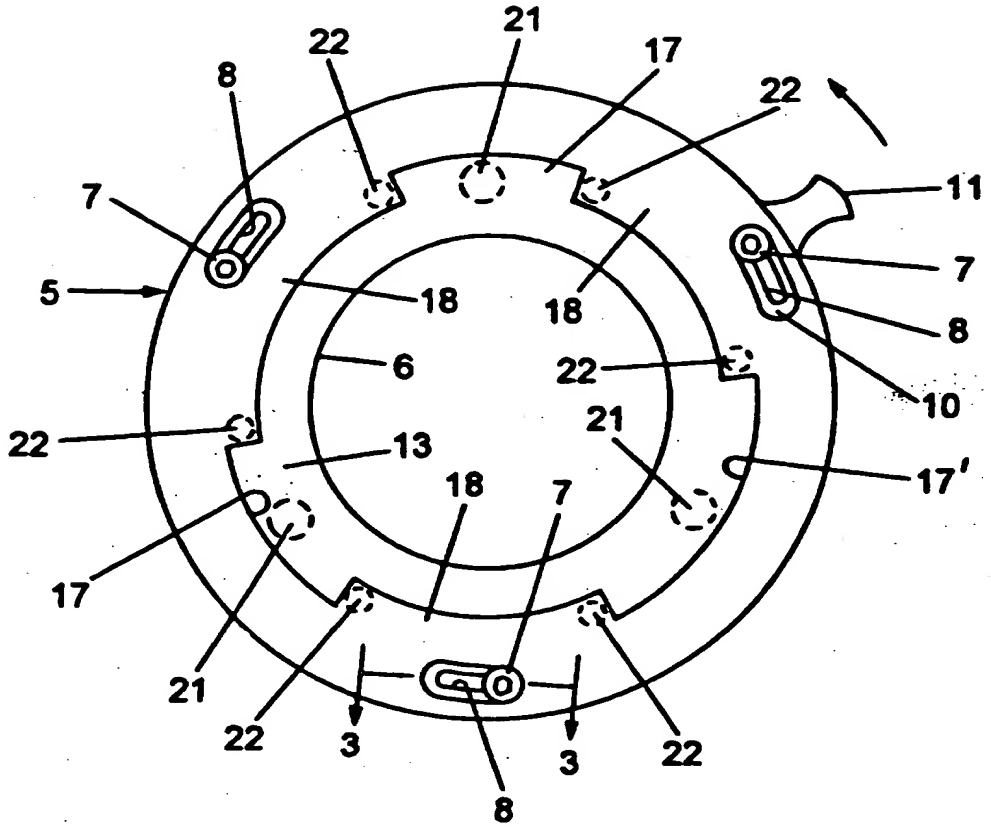
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FIG.2

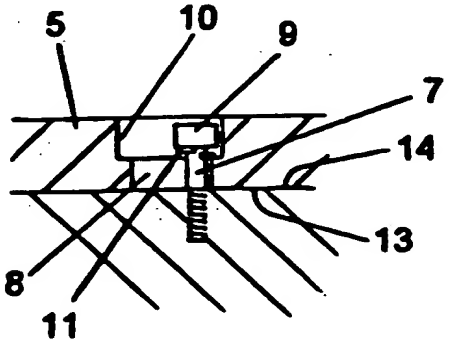
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FIG.3

TITLE

Laser Materials Working Apparatus

DESCRIPTION

Field of the Invention

The invention relates to a laser materials working apparatus for drilling or cutting through materials using a laser beam or for welding. In particular, the invention provides a new and improved mounting for a nozzle of such a laser materials working apparatus

Background Art

A laser materials working apparatus is known, with a capacity to cut or drill through materials or to weld with a five-axis adjustability of the laser beam relative to a workpiece (that is, three mutually orthogonal linear axes x, y and z, and two rotational axes a and b). The laser, which may be for example a CO_2 or a YAG laser, is pulse fired and the resulting beam is first collimated and then focused by a lens or lens system. Between the laser head, from which the beam is initially fired, and the lens or lens system, there may be an arrangement of mirrors for directing the beam to the workpiece. This arrangement of mirrors is known as the laser beam delivery system, and may include varying numbers of rotatable and/or linearly movable mirrors at varying spacing depending on the size and shape of the workpiece. As the size of a workpiece increases, it becomes preferable to incorporate more movement into the laser beam so that less movement of the workpiece is required.

Between the lens and the focal point is a nozzle which stops just short of the focal point and which serves to direct a jet of gas onto the workpiece during cutting, drilling or welding. The gas may be an oxidising gas such as oxygen itself, to aid oxidation and dispersal of

the metal during drilling or cutting, or it may be a non-oxidising gas. The latter is preferred when working magnesium alloys, to avoid the risk of excessive oxidation or even combustion of the metal being worked. The gas reduces back splatter from the molten workpiece onto the lens in use.

Conventionally, nozzles with their optical lens or lens system set in place are screw-threaded, and are simply screwed onto the laser head or a part of the laser beam delivery system if present. Narrow pitch screw threads are used, for accuracy of alignment of the assembled nozzles; and the mounting, dismounting and changing of the lens systems and nozzles is therefore quite a slow and ponderous task.

There are situations in which a lens system and nozzle of a laser machining apparatus must be changed during a machining operation, in which the machining must stop while the old nozzle is unscrewed and a new nozzle selected and screwed into place.

It is an object of the invention to provide an improved mounting for a nozzle of a laser materials working apparatus, which will permit the fitting and changing of the nozzle to be made significantly easier and faster and which will permit the nozzle changing to be automatic if desired.

The Invention

The invention provides a laser materials working apparatus having a nozzle through which a laser beam can be focused on a workpiece, wherein the nozzle is secured to a mounting face on the apparatus by a locate and clamp coupling which holds a face of the nozzle firmly against the mounting face on the apparatus.

The mounting face may be on a laser head from which the beam is initially fired or, if the apparatus includes a beam delivery system for directing the beam, the mounting face may be on a part of this beam delivery system.

Typically, the nozzle may be a gas nozzle including means for directing a flow of oxidising or non-oxidising gas at the workpiece around the focal point of the laser beam. The nozzle preferably houses both the lens system and a transparent cover slide to protect the lens or lens system from back splatter of metal as it is machined. The cone angle of the nozzle can thus be matched to the focal length of the lens system incorporated therein.

The coupling for attaching the nozzle to the mounting face is preferably a rotary coupling, so that the entire coupling action is a push and turn action. The angular extent of the turning component is preferably less than 60°, and is generally about 10° to 30°. The coupling preferably comprises a rotary cam plate which when turned acts to draw and clamp the mounting face and the face of the nozzle together. The cam plate may be mounted on the nozzle or the mounting face, but for either mounting the coupling action is preferably one of pushing the nozzle against the laser head and turning the cam plate so as to draw and clamp the machined faces of the nozzle and laser head together. As the cam plate is turned, the nozzle is held steady against rotation.

Preferably the rotary cam plate comprises a plurality, preferably three, of cam segments angularly distributed around the rotary axis, which pass behind detent lands of a fixed plate as the cam plate is rotated to draw and clamp the two faces together.

Instead of a rotary cam plate, the coupling may comprise a slide or bolt, which is preferably spring loaded, which

has a cam action to draw the nozzle and the mounting face into intimate contact. Alternatively, the entire nozzle could be rotated in a bayonet type of action to hold the faces together.

The simple locate and clamp coupling is much faster to assemble than the conventional screw threaded mountings for the nozzles, and opens up the possibility of an automated nozzle changer, analogous to an automatic tool changer of known mechanical metalworking machines, for changing the focal length of the laser.

Drawings

Fig. 1 is an axial section through a nozzle of a laser machine according to the invention;
Fig. 2 is a front elevation of a laser head having a coupling for holding the nozzle of Fig. 1; and
Fig. 3 is a sectional detail, taken along the line 3-3 of Fig. 2.

Referring first to Fig. 1, there is schematically shown a nozzle 1 of a laser materials working apparatus. The nozzle 1 houses a lens 2, which is shown in Fig. 1 as a single element lens, with a focal length f. The lens 2 is accurately mounted on a conventional lens mounting (not shown) to focus a collimated laser beam entering the nozzle at C, at a focal point F just beyond the end of the nozzle 1. The outer shape of the nozzle 1 is frustro-conical, with a cone angle dictated by the diameter of the lens 2 and the focal length f.

A gas inlet is shown diagrammatically as 3, enabling cooling oxidising or inert gas to be passed through the nozzle 1 and directed onto the workpiece in use at the cutting, drilling or welding zone which is the focal point F. The gas flow itself reduces back splatter of molten metal into the nozzle 1, but the lens 2 is further

protected by a slide cover 4 of optically flat glass.

As so far described, the nozzle 1 is conventional. Conventionally, however, it would be mounted on the apparatus by a narrow gauge screw thread. The nozzle of this invention has a quick release coupling which permits it to be secured to a mounting face on, for example, the laser head by a rapid and simple push and turn locking movement. In the drawings, the mounting face is shown on the laser head. However, if the apparatus included a beam delivery system, the mounting face would be on a part of that system, at the end of the beam path.

Fig. 2 shows a locking ring 5 which is mounted on the laser head, around an opening 6 through which the collimated laser beam is directed. The locking ring 5 is held in position by three retaining cap screws 7, one of which is shown in section in Fig. 3. Each cap screw 7 passes through an arcuate slot 8 formed through the locking ring 5, with a head 9 of the screw being received in a correspondingly larger width portion 10 of the slot 8, so as to retain the locking ring 5 against the laser head while allowing a limited amount of angular movement. The angular limit of movement is dictated by the length of the slots 8, and a radially projecting handle 11 is provided for physically controlling that angular movement.

Spring washers 12 between the heads 9 of the cap screws 7 and the bases of the respective larger width portions 10 of the slots 8 hold the locking ring 5 resiliently against the laser head, as shown in Fig. 3. The cooperating faces of the laser head (face 13, Fig. 3) and the locking ring 5 (face 14) are machined flat, as is the bottom face 15 of the nozzle 1.

The nozzle 1 has an angular array of three arcuate

retaining lugs 16 which in use fit into correspondingly shaped cut-out portions 17 of the retaining ring 5 as the nozzle is pushed into position against the face 13 of the laser head. One of the lugs 16 and one of the cut-out portions (identified as 17' in Fig. 2) has a greater arcuate length than the others, to establish an angular registration so that the nozzle 1 can only be fitted in one angular orientation. Alternatively if angular register were not considered important, the lugs could be identical.

Inner peripheral portions 18 of the locking ring 5 between adjacent cut-out portions 17 are rebated so that as the ring 5 is turned using the handle 11, those peripheral portions 18 slide over the lugs 16 to retain the nozzle 1 on the laser head. The underside of the overhanging peripheral portions 18, or the cooperating shoulders of the lugs 16, or both, are slightly angled so that as the ring 5 is rotated the nozzle 1 is drawn by a cam action firmly against the machined face 13 of the laser head to lock the nozzle 1 in position.

Means are provided for holding the nozzle 1 against rotation as the locking ring 5 is rotated. Two alternative such means are shown, each in broken lines, in the drawings although it will be understood that only one such means would be provided in any single embodiment of the invention.

A first means for holding the nozzle 1 against rotation comprises three locating pins 20 protruding from the flat machined bottom face 15 of the nozzle 1, which engage in three cooperating recesses 21 in the flat machined face 13 of the laser head.

A second means for holding the nozzle 1 against rotation comprises six stop members 22 protruding from the flat

machined face 13 of the laser head beneath the overhanging peripheral portions 18 of the locking ring 5, for engagement with opposite ends of the arcuate lugs 16 of the nozzle 1 as it is pushed into position.

The nozzle coupling illustrated is an integral part of a laser materials working apparatus according to the invention, and opens up the possibility of automatic nozzle changing in such a machine, using technology similar to that of the automatic tool changers of known machine tools.

CLAIMS

1. A laser materials working apparatus having a nozzle through which a laser beam can be focused on a workpiece, wherein the nozzle is secured to a mounting face on the apparatus by a locate and clamp coupling which holds a face on the nozzle firmly against the mounting face on the apparatus.

2. An apparatus according to claim 1 wherein the mounting face is on a laser head from which the laser beam is initially fired.

3. An apparatus according to claim 1 wherein the apparatus includes a beam delivery system for directing the laser beam and the mounting face is on a part of the beam delivery system.

4. An apparatus according to any of claims 1 to 3, wherein the nozzle is a gas nozzle including means for directing a flow of oxidising or non-oxidising gas at the workpiece around the focal point of the laser beam.

5. An apparatus according to any of claims 1 to 4, wherein the nozzle incorporates a focusing lens or lens system for the laser beam.

6. An apparatus according to claim 5, wherein the nozzle also incorporates a transparent cover slide to protect the lens from back splatter of machined material in use.

7. An apparatus according to any preceding claim, wherein the locate and clamp coupling comprises a rotary cam plate which when turned acts to draw and clamp the face on the nozzle and the mounting face together.

8. An apparatus according to claim 7, wherein the

rotary cam plate is mounted on the nozzle.

9. An apparatus according to claim 7, wherein the rotary cam plate is mounted on the mounting face.

10. An apparatus according to any of claims 7 to 9, wherein the rotary cam plate comprises a plurality of cam segments angularly distributed around the rotary axis, which pass behind detent lands of a fixed plate as the cam plate is rotated to draw and clamp the face on the nozzle and the mounting face together.

11. An apparatus according to claim 10, wherein the cam segments are three in number and the detent lands are three in number.

12. An apparatus according to any of claims 7 to 11, wherein the lugs on the nozzle cooperate with recesses associated with the mounting face, to hold the nozzle against rotation as the cam plate is turned to draw and clamp the face on the nozzle and the mounting face together.

13. An apparatus according to claim 12, wherein the lugs are three in number.

14. A laser materials working apparatus having a quick change nozzle substantially as described herein with reference to the drawings.

15. An automatic nozzle changing mechanism for a laser materials working apparatus according to any preceding claim, comprising nozzle handling means for drawing a nozzle from a store, presenting it to the mounting face and clamping it onto the mounting face by an appropriate clamping movement of the coupling.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)

Application number
GB 9506825.0

Relevant Technical Fields

(i) UK Cl (Ed.N) B3V, B3R

(ii) Int Cl (Ed.6) B23K

Search Examiner
D N P BUTTERS

Date of completion of Search
13 JUNE 1995

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii)

Documents considered relevant following a search in respect of Claims :-
1-15

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	US 5366164	(PRECITEC) see Figures 8, 9	1-5, 15
X	US 4665607	(RASKIN) see column 8 lines 57, 58	1-4

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